SUPERFUND RESPONSE ACTION PRIORITY PANEL REVIEW FORM				
Date Form Completed:	February 22, 2013			
General Site Information				
Region:	Region 8	City: Ward	State:	Colorado
CERCLIS EPA ID:	COD981551427	CERCLIS Site Name:		Captain Jack Mill
NPL Status: (P/F/D)	Final (F)	Year Listed to NPL:		2003

Brief Site Description: *(Site Type, Current and Future Land Use, General Site Contaminant and Media Info, Site Area and Location information.)*

Site Type: The Captain Jack Mill Site consists of a draining mine adit and associated impacted surface water and groundwater. Waste materials from mining and milling operations and contaminated residential soils were addressed in a previous remedial action. Mining for gold and silver began in this region in 1861 and continued intermittently until 1992.

Land Use: Site ownership is mostly private. Currently one residence is within the Site boundary and a few residences are downgradient of the Site on adjacent properties. In the past a family lived in a structure associated with the mill buildings and other onsite structures (buses, trailers) often housed transients. Many of these structures were removed during the surface remedy remedial action. Recreational use of the area is not restricted. Property boundaries largely follow historic mining claims. Boulder County and Bureau of Land Management (BLM) properties are also located within the Site boundary.

Site Contaminants and Media: Acid rock drainage from the Big Five mine tunnel discharges to Left Hand Creek. Contaminants of concern are heavy metals including aluminum, arsenic, cadmium, copper, lead, manganese, nickel and zinc. Several of these metals are elevated in local ground water and in the surface water and sediments of Left Hand Creek, which is the primary contaminant transport mechanism. Left Hand Creek runs through the Site and is a drinking water source for the Left Hand Water District, which treats and provides drinking water to more than 15,000 people in rural Boulder and Weld Counties in Colorado. Surface water aquatic life standards are exceeded for cadmium, copper and zinc.

Prior to implementation of the surface remedy in 2012, the greatest risk factors were associated with the presence of arsenic, lead and thallium in surface soils. Surface soils provided the primary exposure route for onsite residents, and erosion and leaching of contaminated waste piles and soils was a principal transport mechanism of contaminants into surface water and the surrounding areas. These issues were addressed with the surface remedy. The current request is for the subsurface remedy which deals with the contamination in the Big Five tunnel discharge and mine pool water.

Site Area and Location: The Site is located near the town of Ward in Boulder County, Colorado at 8,550 to 9,040 feet above mean sea level (amsl). It is located at the headwaters of the Left Hand Creek Watershed in a narrow valley. The underground workings of the Big Five tunnel extend a considerable distance west of the Peak to Peak Highway. A crosscut tunnel connects the Big Five workings with other workings associated with the Columbia Vein.

General Project Information			
Type of Action:	Remedial	Site Charging SSID:	08A3
Operable Unit:	01 (only 1 OU) Phase 2	CERCLIS Action RAT Code:	RA002
Is this the final action for the Site that will result in a site construction completion? *(Answer will be yes, if Phase 2 is successful and Phase 3 is not needed)*		☐ Yes	☒ No
Will implementation of this action result in the Environmental Indicator for Human Exposure being brought under control? *(Answer will be yes, if Phase 2 is successful and Phase 3 is not needed)*		☐ Yes	☒ No

Response Action Summary

Describe briefly site activities conducted in the past or currently underway:

The RI/FS was conducted between 2004 and 2008. During this time three EPA Emergency Removal Actions were also conducted. The first removal action was to investigate a reported mercury exposure. The second removal action was a material and chemical removal operation from the Captain Jack Mill building. The third removal action was to eliminate the first of several rock cave-ins which created an un-engineered impoundment of acid mine drainage within the Big Five mine workings.

The ROD was signed 9/29/08. Site remedial activities were split into two parts, the surface contamination (also referred to as Phase 1 and the subsurface contamination (Phase 2). The surface remedy RA construction was finished in November 2012. The completion report is in preparation. The surface remedy consolidated mine waste and contaminated soils into two consolidation cells at the Site. The consolidation cells were capped with a vegetated soil cover. Excavated areas were amended and revegetated.

The design for the subsurface remedy has included pre-design field investigations and is nearly complete. The 90% complete design drawings and specifications have been received and reviewed by EPA and CDPHE. A Value Engineering Screen was completed in March 2012 by the US Army Corps of Engineers.

Specifically identify the discrete activities and site areas to be considered by this panel evaluation:

This application is for implementation of the subsurface contamination remedy (Phase 2). The remedy will include installation of a flow control bulkhead in the Big Five tunnel, and an in-tunnel treatment system to inhibit the generation of acid mine drainage in the workings behind the bulkhead by submerging source materials. A comprehensive monitoring system will ensure contaminated water is not impacting Left Hand Creek from new locations via seeps or non-point source loads caused from the installation of the bulkhead and the 'in tunnel' or in-situ treatment system.

The objective of the remedy is to bring ground water back toward pre-mining elevations to impede the oxidation of acid generating minerals and restore the ground and surface water quality. A section of the mine tunnel will be packed with limestone prior to flooding. A mine pool treatment system will consist of the addition of a neutralizing agent (caustic) and recirculation of water through a section of the tunnel. It is expected that treatment (caustic addition and recirculation) will be required initially as the mine tunnel floods, and may be required on a periodic basis thereafter.

The monitoring system is designed to track changes to the groundwater elevation and quality in the vicinity of the mine tunnel area and the downgradient area over time. A geophysical monitoring array will be installed along with a network of monitoring wells. A valved pipe installed through the bulkhead will allow the release of water from the tunnel should it be necessary. If improvements to the water quality are not sufficient to achieve the surface water RAOs, a third phase was identified as a contingency in the ROD. The third phase would include design and construction of a passive/semi-passive type bioreactor system for additional treatment of the mine tunnel discharge.

This remedy is a novel treatment technology aimed at restoring ground and surface water quality and reducing long term O&M costs for treating mine influenced water. The system will be flexible, such that other amendment types including organic carbon could be utilized in the future, if initial flooding and neutralization do not impede oxidation of subsurface acid generating minerals to a sufficient level.

Briefly describe additional work remaining at the site for construction completion after completion of discrete activities being ranked:

If needed for further treatment or polishing of the Big Five tunnel discharge waters, a third phase to design and install an external bioreactor treatment system or other passive/semi-passive type technology, will be added. The ROD anticipates a two year observation period of the Phase 2 remedy to determine the need for Phase 3.

Response Action Cost

Total Cost of Proposed Response Action:

($ amount should represent total funding need for new RA funding from national allowance above and beyond those funds anticipated to be utilized through special accounts or State Superfund Contracts.)

The cost of the subsurface contamination remedial action is estimated at $3,290,000. Since the State will cost share 10%, **$2,960,000 is currently requested** for the subsurface contamination (Phase 2) remedial action. The State will provide a 10% cost share estimated at $329,000.

An additional estimated $2,000,000 may be required in the future to implement Phase 3 remedial action (ex-situ bioreactor) to further treat the Big Five tunnel discharge, if the in-situ treatment is not meeting the RAO's.

The surface remedy (Phase 1) was constructed on schedule and under budget. It is anticipated that $900,000 remains from the surface remedy (Phase 1) RA. Final billing is pending the completion of the construction report and determination of operational and functional for Phase 1.

Remedial Action	Total Cost	State Share (10%)	EPA Share (90%)
Surface Contamination Phase 1	Complete	Complete	Complete
Subsurface Contamination Phase 2	**$3,290,000**	**$329,000**	**$2,960,000**
Subsurface Contamination Phase 3 – if required	$2,000,000 (estimated)	$200,000	$1,800,000
Total Remaining	$5,290,000	$529,000	$ 4,760,000

Source of Proposed Response Action Cost Amount:

(ROD, 30%, 60%, 90% RD, Contract Bid, USACE estimate, etc...)

A 90% Remedial Design for the subsurface contamination (Phase 2) RA, developed by AMEC, is the cost source for the subsurface remedy. Contract administration costs, field oversight costs, and operational and functional demonstration period costs were developed by CDPHE and have been added to the RA construction costs. The operational and functional (O&F) demonstration period is planned for 2 years corresponding to the 2 year monitoring period designated in the ROD to determine if Phase 3 is needed. RA completion would be achieved after this O&F period. *Costs are rounded to the nearest $10,000.*

Possible future funding needed for Phase 3 remedial action is estimated from the ROD with adjustments for contract administration costs and inflation.

Breakout of Total Action Cost Planned Annual Need by Fiscal Year: *(If the estimated cost of the response action exceeds $10 million, please provide multiple funding scenarios for fiscal year needs; general planned annual need scenario, maximum funding scenario, and minimum funding scenario.)*
$2,960,000 is required in FY13 to bid out and construct the subsurface remedy. If funding is received in spring 2013, the construction can occur in 2013. However, due to the high elevation at the Site and the strong potential for adverse weather, if funding is delayed until Summer 2013 or later, project construction will be delayed until 2014. The construction will take place in one field season. The ROD provides for 2 years of monitoring post construction to assess whether Phase 3 will be required. Additionally, the first two years after the Phase 2 remedy is installed are expected to require more intensive monitoring and operational adjustments to the recirculation rate and caustic additions than will be anticipated in future years. Therefore a 2 year O&F demonstration period is proposed corresponding to the 2 year monitoring period. A 10 year LTRA is anticipated. The ROD specifies this remedy will undertake restoration of the ground and surface waters by treating mine water "in-situ". Since it is unknown yet if the bioreactor (Phase 3) will be needed, two potential LTRA costs are listed in the table below: Option A includes only the in-situ (in-tunnel-Phase 2) remedy, Option B includes both the in-situ and the ex-situ (bioreactor- Phase 3) remedy.

Exemption 5: DP

[redacted]

Other information or assumptions associated with cost estimates?
The surface remedy was completed under budget. Therefore, of the $2,960,000 EPA funds required to implement this remedial action, approximately $900,000 remaining in the existing cooperative agreement could be utilized toward the requested amount. This would result in a new award of only $2,060,000.
Readiness Criteria
1. Date State Superfund Contract or State Cooperative Agreement will be signed (Month)?
The work for Phase 2 will be added as an amendment to the existing Cooperative Agreement initiated for RA Phase 1, awarded August 9, 2011. The Amendment can be signed by April 2013.
2. If Non-Time Critical, is State cost sharing (provide details)?
Not applicable for Remedial Action
3. If Remedial Action, when will Remedial Design be 95% complete?
April 1, 2013
4. When will Region be able to obligate money to the site?
April 1, 2013
5. Estimate when on-site construction activities will begin:
June 1, 2013
6. Has CERCLIS been updated to consistently reflect project cost/readiness information?
Yes

Site/Project Name:	**Captain Jack Mill**

Criteria #1 - RISKS TO HUMAN POPULATION EXPOSED (Weight Factor = 5)
Describe the exposure scenario(s) driving the risk and remedy. Include risk and exposure information on current/future use, on-site/off-site, media, exposure route, and receptors:
Health hazards include direct, waterborne and food chain exposures. Exposure pathways include dermal contact and ingestion. Left Hand Creek transects the Site and is impacted by Site contaminants. The creek is the primary contaminant transport mechanism. Left Hand Creek is a Class I Cold Water fishery, and has Water Supply, Agriculture and Recreational use designations. Currently 3 onsite residents may be exposed to surface and ground water. Transient residents also occasionally inhabit abandoned structures on the Site (estimated at 5 unique individuals per year). Shallow, hand-dug wells are located near Left Hand Creek, and may be used as a drinking water supply for permanent or transient residents, although residents have been advised against ingesting this water. Owners of at least two additional private land parcels plan to build residences in the future. Much of the adjacent area is publicly owned and there are trails and historic features. Recreationists visit the Site for hiking, biking and picnicking (estimated at 20 plus unique individuals per year). Left Hand Canyon, between Boulder and Ward, is a popular bike route. No public source of potable water is available at the Site.

Over 15,000 downstream residents are supplied with drinking water from Left Hand Creek. Although the drinking water intake is not currently impacted, there is the potential for contaminants to be released from the Site. A severe storm event could carry contaminated stream sediments downstream. Additionally, un-engineered impoundments have been observed within the tunnel. A sudden release of pooled water behind mine tunnel collapse areas could result in large volumes of contaminated water impacting the drinking water intake.

Remedial Investigation Human Health Risk Assessment Summary

Exposure to surface water by residents or recreationists by ingestion or dermal contact produced noncancer Hazard Quotients (HQ) ranging from below 1 to 3, and cancer risks ranging from less than 1.0×10^{-6} to 1.5×10^{-3} for inorganics based on the assumptions used in the risk assessment. Use of surface water as the sole drinking water source produced higher risk estimates than dermal contact or incidental use. Risks for recreationists were lower than those for residents.

Exposure to groundwater (if pumped for drinking water) by residents produced noncancer risks as indicated by HQs greater than 1 for cadmium and zinc (2.2 and 2.1 respectively).

Mine water ingestion is unlikely. However, if mine water was used as a sole drinking water source it could produce excess cancer risks for arsenic or chromium as high as 3.2×10^{-3} and elevated noncancer HQs as high as 10 under the exposure assumptions used in the risk assessment.

Ingestion of fish produced excess cancer risks for arsenic and chromium based on the assumptions used in the risk assessment. There were no excess noncancer risks due to consumption of fish from the Site. The RI indicated that no thriving fishery was noted in the immediate Site vicinity, however fish were often observed during implementation of the surface remedy.

Estimate the number of people reasonably anticipated to be exposed in the absence of any future EPA action for each medium for the following time frames:

MEDIUM	<2yrs	<10yrs	>10yrs
Surface water	28	100	15,000
Alluvial ground water wells in communication with surface water	7	12	20

Discuss the likelihood that the above exposures will occur:

Onsite residents and recreationists are currently exposed to contaminated surface water. Onsite residents and transients are very likely currently exposed to contaminated ground water from the use of unpermitted hand dug wells. The exposures due to soils and waste materials identified in the RI and the ROD were addressed with the surface remedy.

Future projections of the number of people anticipated to be exposed increases over time due to assumed increases in resident population in the immediate Site area and assumed increase in number of unique individuals that will use the area for recreation over time.

Downstream recipients of drinking water from LHC may be exposed if the Big Five mine tunnel blows out and releases a large quantity of contaminated acid mine drainage. Although the Left Hand Water District treats water from LHC at their Spurgeon plant, their system could be overwhelmed by a sudden blow out of the

collapsed tunnel sections and subsequent release of water. No physical or programmatic protections are in place. The surface remedy addressed the potential for a storm event to impact downstream water users due to run off from waste sources, however, discharge of contaminated water and associated sediments from the Big Five tunnel is still a threat.	
Other Risk/Exposure Information?	
The condition of the Big Five tunnel beyond the first 800 feet of tunnel length is unknown. The tunnel may hold a significant volume of impounded contaminated water. Impact to the Left Hand Water District's drinking water supply from a significant mine tunnel blowout could occur at any time. This risk will be addressed by the subsurface remedial action (Phase 2).	
Site/Project Name:	**Captain Jack Mill**
Criteria #2 – SITE/CONTAMINANT STABILITY (Weight Factor = 5)	
Describe the means/likelihood that contamination could impact other areas/media given current containment:	
Surface water aquatic life standards are currently exceeded for cadmium, copper and zinc in portions of Left Hand Creek. Sediment samples have elevated arsenic, lead, manganese and thallium concentrations. The surface remedy addressed significant sources of metal laden sediment transport to the surface water. However, the continuous discharge of acid mine drainage from the Big Five tunnel continues to be a significant contributor to metals, both dissolved and solid, to the Left Hand Creek. A reconnaissance into the Big Five tunnel in 2007 identified water impounded behind collapses. One impoundment was removed, but others remain. At any time, an impoundment could break and release a large volume of contaminated water into Left Hand Creek.	
Are the contaminants contained in engineered structure(s) that currently prevents migration of contaminants? Is this structure sound and likely to maintain its integrity?	
No (for acid mine drainage source).	
Are the contaminants in a physical form that limits the potential to migrate from the site? Is this physical condition reversible or permanent?	
No. Contaminants include dissolved and particulate metals discharged into the surface water and transported downgradient.	
Are there institutional physical controls that currently prevent exposure to contamination? How reliable is it estimated to be?	
A sign at the Site notifies individuals of the hazards, but no physical barriers are in place. No other institutional controls have been applied to date. Environmental Covenants/Restrictive Notices are planned to protect the surface remedy mine waste consolidation cells as well as future remedy components of the subsurface remedy.	
Other information on site/contaminant stability?	
It is generally understood in the scientific literature that metals transport in surface waters is controlled by several interacting chemical and physical reactions which determine the solubility and mobility of the metal contaminant. These reactions include but are not limited to absorption/desorption from particles, chemical or photo catalyzed oxidation-reduction reactions, and physical transport mechanisms. Therefore, the extent of contaminant transport downstream can be stream-reach specific and can change seasonally.	

Site/Project Name:	**Captain Jack Mill**

Criteria #3 – CONTAMINANT CHARACTERISTICS (Weight Factor = 3)

(Concentration, toxicity, and volume or area contaminated above health based levels)

List Principle Contaminants (Please provide average and high concentrations.):

(Provide upper end concentration (e.g. 95% upper confidence level for the mean, as is used in a risk assessment, or maximum value [assuming it is not a true outlier], along with a measure of how values are distributed {e.g. standard deviation} or a central tendency values [e.g., average].)

Contaminant	*Media	**Concentrations
Cadmium	SW	0.00278 mg/L mean; 0.00726 mg/L max; n=12
Copper	SW	0.581 mg/L mean; 1.42 mg/L max; n=12
Iron	SW	22.2 mg/L mean; 111 mg/L max; n=12
Manganese	SW	3.42 mg/L mean; 7.3 mg/L max; n=12
Zinc	SW	0.614 mg/L mean; 1.46 mg/L max; n=12

*(*Media: AR – Air, SL – Soil, ST – Sediment, GW – Groundwater, SW – Surface Water)*

*(**Concentrations: Provide concentration measure used in the risk assessment and Record of Decision as the basis for the remedy.)*

The concentrations above were used in the risk assessment to assess likely surface water exposure. Data is the total metal fraction. Higher concentrations of some contaminants were detected directly in the mine-pool water.

Describe the characteristics of the contaminant with regards to its inherent toxicity and the significance of the concentrations and amount of the contaminant to site risk. *(Please include the clean up level of the contaminants discussed.)*

Drinking water standards for copper, cadmium, and manganese are exceeded in the AMD. Several locations along the Left Hand Creek exceed the drinking water standard for manganese. Surface water aquatic life standards were exceeded in Left Hand Creek for cadmium, copper, and zinc.

Cadmium

Human ingestion exposure to high cadmium levels can severely damage kidney, liver and bone health. Vegetables and other plants absorb cadmium easily, and can be extremely dangerous when eaten. Aquatic organisms can vary greatly in their sensitivity to cadmium from sublethal to lethal effects. Cadmium was detected as high as 0.0081 mg/L in the mine-pool water.

Copper

Elevated levels of copper are toxic in aquatic environments and may adversely affect fish, invertebrates, plants, and amphibians. Acute toxic effects may include mortality of organisms; chronic toxicity can result in reductions in survival, reproduction, and growth. In humans, small amounts of copper are necessary to maintain good health; however, higher concentrations of copper may cause health effects such as irritation of the nose, mouth, and eyes; nausea; and diarrhea. Brief exposure to high levels of copper can cause flu-like symptoms, while long-term exposure can result in liver and kidney damage. Copper was detected as high as 2.5 mg/L in the mine-pool water.

Iron

Iron toxicity is possible from ingestion of very large amounts of iron. In aquatic environments iron loading to a stream can significantly impair benthic habitat and it plays a role in mobility/stabilization of other heavy metals.

Manganese

Long-term exposure to manganese can result in central nervous system damage.

Zinc

Zinc is a trace element essential for human health. Although humans can handle proportionally large concentrations of zinc, too much zinc can cause stomach cramps and skin irritation and may lead to inhibition of copper uptake. At very high levels, zinc can cause arteriosclerosis. Zinc can be toxic to fish and other aquatic organisms which can also accumulate zinc and pass it to animals higher on the food chain. Zinc was detected as high as 1.73 mg/L in the mine-pool water.

Describe any additional information on contaminant concentrations which could provide a better context for the distribution, amount, and/or extent of site contamination. *(e.g. frequency of detection/outlier concentrations, exposure point concentrations, maximum or average concentration values, etc…..)*

Metals released from the various sources in the study area are accumulating in the aquatic insects and vegetation of Left Hand Creek. The Lefthand Watershed Oversight Group (LWOG) (2005) sampled aquatic insects throughout the entire Left Hand-James Creek Watershed and found the highest values of zinc, copper, and lead in the watershed in the California Gulch section of the creek, with zinc values reaching 1.8 mg/kg in insect body tissues.

Other information on contaminant characteristics?

The remedial action is designed to meet surface water quality criteria at the downstream point of compliance (POC) prior to leaving the Captain Jack Mill Site and diversion into drinking water sources.

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Criteria #4 – THREAT TO SIGNIFICANT ENVIRONMENT (Weight Factor = 3)
(Endangered species or their critical habitats, sensitive environmental areas.)

Describe any observed or predicted adverse impacts on ecological receptors including their ecological significance, the likelihood of impacts occurring, and the estimated size of impacted area:

Left Hand Creek flows through the Site and has a Class 1 Cold Water Aquatic Life designation. Surface water aquatic life standards are exceeded for cadmium, copper and zinc. Acid mine drainage from the Big Five tunnel into the Left Hand Creek is a principal transport mechanism. Fish populations appear to be impacted along the lower reaches of the Site. Metals accumulation has been demonstrated in aquatic insects in Left Hand Creek. Left Hand Creek is impacted for the ¾ mile it runs through the Site. It is likely that the creek is also impacted for some distance downstream, but studies have not been conducted to confirm this. Additionally, extensive wetlands are present for approximately 2.5 miles downstream of the eastern boundary of the Site.

Downstream of the Site, Left Hand Canyon is considered a Potential Conservation Area by the Colorado Natural Heritage Program, due to its significant biodiversity. The area supports a good occurrence of globally vulnerable montane riparian forest. Boulder County also has documented records for the state imperiled northern redbelly dace, and an occurrence of the state rare Theano alpine butterfly.

Would natural recovery occur if no action was taken? If yes, estimate how long this would take.	☐ Yes ☑ No
Natural Recovery will not occur in human time scales.	
Other information on threat to significant environment?	
The ecological risk assessment calculated Hazard Quotients (HQ) greater than 1 for aquatic life exposed to surface water. During sampling events for benthic invertebrates and fish, both populations appeared drastically reduced compared to expected population size in similar streams in this ecological zone.	

Site/Project Name:	**Captain Jack Mill**

Criteria #5 – PROGRAMMATIC CONSIDERATIONS (Weight Factor = 4)
(Innovative technologies, state/community acceptance, environmental justice, redevelopment, construction completion, economic redevelopment.)

Describe the degree to which the community accepts the response action.

EPA and the State originally identified the Site as NPL caliber in 1999. At that time, the local community was very opposed to listing. In 2001, the Lefthand Watershed Task Force was funded through Boulder County Public Health Department to evaluate several mining impacts in the watershed and to present findings to the community. The group's recommendations led to a turnaround in public opinion and the Captain Jack Mill Site was listed on the NPL in 2003. Several other mining impacted sites within the watershed are being addressed through other programs including Voluntary Cleanup, RCRA Corrective Action, and USFS non-time critical removal.

The community has been involved in the development of the design, and is supportive of the response action. This includes Boulder County, Town of Ward, Lefthand Watershed Oversight Group and Lefthand Creek TAG Coalition. Community input on the Proposed Plan resulted in the selection of the most thorough surface cleanup remedy alternative. EPA also received comments related to preservation of historic structures: boarding house, rock wall, Camp Francis and the Conqueror Mill. These features were protected in the design and installation of the surface remedy and are not anticipated to be disturbed during the subsurface remedy. Additionally, community comments were received requesting robust monitoring of water quality during implementation of the subsurface remedy to evaluate effectiveness and to detect negative impacts if they should occur. A monitoring plan has not been developed yet, but an extensive monitoring system is designed and Region 8 and CDPHE recognize the need for robust monitoring to evaluate the effectiveness of this novel remedy.

Describe the degree to which the State accepts the response action.

The State is the lead agency on the Site, and Region 8 EPA and the State are in full concurrence on the response action.

Describe other programmatic considerations, e.g.; natural resource damage claim pending, Brownfields site, use of innovative technology, construction completion, economic redevelopment, environmental justice, etc…
The subsurface remedial design is an application of innovative technology including plugging the mine tunnel and providing in-situ treatment of the mine pool. The objective of the remedy is to reduce production of acid mine drainage rather than actively treating the discharge. This remedy is anticipated to reduce the long term operating costs that are typical in treating acid mine drainage discharges. There have been other sites around the country that have used mine tunnel plugging in an attempt to restore ground water levels and quality to pre-mining conditions. However, in this case the ability to recirculate the mine water and add amendments to the mine pool in-situ allowing in-tunnel treatment is novel. We expect to learn information and techniques from this remedy that could be utilized at other mine sites with the overall goal of reducing mine water treatment costs regionally and Nationally. Additionally, solar power will be utilized to operate much of the monitoring system.